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Human capacity and institutional development towards a sustainable energy future in Ethiopia

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Abstract

The overwhelming majority of Ethiopians lack access to modern energy fuels such as electricity and liquid petroleum gas, still locked into a biomass-based energy system. As such, women and children in rural areas spend long hours of productive time and labour on woodfuel collection and the urban poor spend a sizeable proportion of their income to meet their daily energy needs. Electricity, which is at the disposal of every household in Western Europe is largely restricted to the urban centres in Ethiopia, hence indicating a strong correlation between lack of access to modern energy and poverty. The paper will analyse the reasons why Ethiopia is lagging behind the rest of the developing world in setting up a sustainable energy pathway. As such, the performance and 'mind-set' of various 'agencies', i.e. higher education system, government, energy authorities, donor agencies, etc. will be reviewed. The paper refers to a range of cases in to illustrate the challenge of building the mechanisms that allow energy technologies to be successfully disseminated, supported and integrated into rural livelihoods. The paper will provide a series of observations and recommendations to ameliorate the current state-of-affairs and ways through which the various actors (community-based organisations, government at various levels and to a lesser degree, donors) can contribute towards that end.

Keywords: Sustainable energy; Ethiopia; Capacity building

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1. Introduction

At the heart of any sustainable energy strategy lies the vision of providing all citizens with sufficient quantity of modern energy services. This has two important features. Firstly, the provision of adequate energy services must go beyond the 'achievement' of economic growth and incorporate the satisfaction of basic human needs and improve social welfare. Secondly, the production and use of energy should not endanger the quality of life of current and future generations and should not exceed the carrying capacity of ecosystems [1]. Indeed, we are already witnessing mounting evidence of urban air pollution, regional acidification in some parts of the world and risks of human induced climate change associated with fossil fuel use. Reversing this pattern of unsustainable practice will require policies and interventions with the deliberate mission to accelerate technological innovation at every stage of the energy innovation stage, mobilising additional investment in technologies that exploit local resources and initiate a programme that gives attention to the development of human and institutional capacity.

Significant challenges lie ahead for oil-importing developing countries as they continue to endure serious balance of payments problems, which leave little room for manoeuvring their way out of their current energy dilemma. Nowhere is this challenge more acute and urgent than in the Horn region of Africa where the lack of energy infrastructure presents formidable impediments to social and economic progress. Here, well over three-quarters have no access to modern fuels or electricity, millions of women and children spend long hours on fuel collection duties, and the urban poor spend a sizeable proportion of their income to meet their minimum daily energy needs.

The energy consumption of the average Ethiopian is among the lowest in the world. The World Bank (2001) gives the per capita figure of 287 kg of oil equivalent (kgoe)/year. Furthermore, the Ethiopian energy profile has its inherent distributional asymmetries associated with the distortions of a dualistic economy: a small monetised and a large non-monetised sector. The disparity between the per capita usage of traditional and modern fuels is even more alarming with traditional fuels accounting for about 265 and 22 kgoe, respectively. This effectively classifies Ethiopia as one of the least energy intensive economies, heavily constrained by both low quality of fuel type and low per capita energy

consumption. Therefore, there is much room for Ethiopians to increase their energy consumption and move towards fuels that are both benign and available in sufficient quantity within their national borders. Along this path, some fundamental questions need to be not raised: how, with what modalities, at what rate, and using which alternatives should this difficult yet essential shift towards better quality and enhanced quantity energy framework take place? The issue of enhancing technical and institutional capacity is central to this question. The paper will pay particular attention to the conditions in rural areas where over 85% of the Ethiopian population currently reside.

2. Sustainable energy within the Ethiopian context

Ethiopia currently finds itself at a momentous development and resource threshold. Its present population stands at about 75 million with an annual growth rate of about 3% [2], and if the present trend remains unabated the number of people will reach 120 million by 2025. The implications of this are that the pressure for land and resources will intensify as the country stretches beyond its natural limits to sustain its rapidly growing population. More and more biomass and fossil fuels will be needed to satisfy the growing energy demand, which will impose considerable pressure on the country's environment and resource base. Paradoxically, it is precisely this diminishing biomass stock, which will continue to be the principal source of energy for the great majority of Ethiopians. This alone calls for a radical rethink of the energy path the country finds itself.

Moreover, Ethiopia will continue to import fossil fuels (which it can ill afford) to satisfy the 5–6% annual growth in commercial energy use in the modern sector as well as largely urban households. The escalating price for oil in the world market over the past 3 years has applied considerable pressure on the economy. The government continues to subsidise local petroleum consumption, spending about US \$110 million in 2005, which cannot continue indefinitely before some of the costs are transferred to the consumers [3]. This has major economic implication not least in the way that these increases of fuel expenditure will impact on external debt. Already the country has a US \$6.4 billion external debt, which is about 30% of Gross National Income [2] and behind this increasing trend towards further debt is expenditure for energy imports.

The real paradox in this is that the country is relatively rich in resources. In recent years, there have been studies indicating that Ethiopia may be sitting on modest amounts of fossil fuel reserves and has huge hydro resources, of which less than 2% have been harnessed as yet. The total annual solar radiation reaching the territory is in the order of over 200 million toe/year,[1] over 12-fold the total annual energy consumption in the region, while the total wind resource potential amounts to 42 million toe/year, which also exceeds gross energy consumption by about 2.5 times [4,5].

The reasons as to why the country has not succeeded in providing access to adequate energy resources to its citizens needs further interrogation, particularly given the considerable potential of energy resources available within its borders. What is clear is that having the *potential* does not automatically translate into usable resources. Availability of resources important, but other conditions would also need to be met if the aims of sustainable energy are to be realised, which include viable markets, the right

[1]toe = tonne of oil equivalent.

mix of policies and the political will to see widening access to energy as an important strategic priority. However, one of the most overlooked factors in sustaining energy programmes is the quality and resilience of capacity, both human and institutional, that provides the support structure (and incentives) for innovation and creativity.

3. Capacity development for rural energy

The ability of a society to institutionalise rural energy development and social progress is determined not only by the availability of energy resources (which are all passive agents) but also by the capabilities of its people, institutions, and organisations to evaluate development options and implement actions. In essence, the capacity of a society is incarnated in its people (their skills, ideas, knowledge, talents, and creativity); its institutions (economic, social and political); and its organisations (public and private). These are reinforced by non-cognitive factors such as norms, values, beliefs, ideals, process and procedures. For there to be sustainable technology development, a society must have management and technical infrastructure to upgrade and replenish its stock of skills and knowledge on a continuing basis. Building and maintaining the requisite technical and management infrastructure as regards to the rural energy sector requires constant adjustment, modification, and elaboration of the institutions to reflect the changes in time and space. These require policy makers and managers with the capacity for anticipatory adaptation to change and understand that the development and adaptation of technologies in rural areas is a dynamic process.

The challenge of capacity building appears to be given some seriousness by the current Government of Ethiopia so much that it has been given its own ministerial department. The creation of this institution does not mean that there is no capacity in existence and therefore the country must start from scratch. Rather it means the building up and strengthening of capacity as well as retaining existing capacity, improving the utilisation of capacity, and retrieving capacity, which has been eroded or destroyed [6]. Capacity development in the context of the rural energy therefore refers to the capacity to refine existing (indigenous) energy technologies as much as the capacity to efficiently adapt exogenous technologies into the wider energy system. The implications of this depiction are that capacity development must be achieved at different levels: the individual, institutional, and systemic.

3.1. Energy and human capacity building

Human capacity building is the process of equipping individuals with the understanding, skills and access to information, knowledge and training that enables them to perform their tasks effectively. In essence, it is the product of a continual interaction between society and the individual in which opportunities made available by the former are accessed by individuals. Human resource is therefore vital in the process of making technology choices and promoting sustainable development. But in spite of government efforts to develop the human resource (engineers, technologists, trained technicians, managers) in the energy sector in Ethiopia there is a continuing shortage of personnel armed with the essential skills to respond to technical demands at various levels.

In concrete terms, research and development, technology transfer, manufacturing, and maintenance and repairs all require the availability of adequate skilled and semi-skilled

technical human resource. Insufficient local and national technical staff and support organisations can present a significant hurdle in developing and implementing rural energy programmes. The form of human resource needed in the wider rural energy sector vary depending on the type of technology, local and regional energy supply/demand profile, and the type of technical support needed at various levels (national, regional and local). These are all influenced by a range of factors such as whether the technology is locally manufactured or imported, the proportion of components, which are imported, and the type and nature of maintenance needed. Thus, the requirements for a given level and type of energy service, which is related to a given technology choice, will determine the technical and non-technical skills that are required to ensure sustainability.

3.2. Research and development, and high-level training

There is ample space to strengthen R&D activities in energy technologies at national and regional levels in Ethiopia. The down side of this is that the process of assembling a reasonable R&D capacity requires substantial financial resources and a pool of highly trained and motivated 'manpower', which is not readily available in the country. Therefore, it is essential to make the most efficient use of limited research training funds and to better achieve research objectives, and the role national energy institutions to facilitate the process is vital.

The reference to 'strengthening academic system' is not only directed to higher education, but sensitising younger students (primary and secondary level) about important local energy issues in the existing school curricula. Creating awareness from a young age regarding the real problems in their immediate environment, and employing process-oriented teaching methods with an emphasis on problem-solving approaches are seen as vital in preparing student for a rewarding higher education. The adoption of the process-oriented science and technology education will require a series of institutional innovations whereby new teaching curricula will have to be designed, new test methods and materials will have to be developed, and new community science teachers will have to be trained.

Higher education systems will need to be more relevant by responding to local and regional training requirements. As yet, one can observe only a token gesture to include energy technologies in their curriculum with most energy-related material focusing on conventional energy systems. For example, despite wood-based fuels being used by over 90% of the population, there are no biomass research centres in Ethiopia with the mandate to nurture expertise across the country. This failure to develop a sound and appropriate technical base goes to the heart of the country's difficulty in grappling with the reality of the limited choice and opportunities available to it. In the words of one official from the Head of the Water and Energy Bureau in Dire Dawa:

> …The issue concerning the development of indigenous technological capacity is an old terrain of rhetoric which has been part of the Ethiopian development vernacular for quite sometime. Quite often 'indigenous technology' was just a convenient political catchword, which had no real link with people and their environment. The current use of the term 'indigenous technology' may still contain the same idiosyncratic pretensions. But they are mainly expressions of fear and alarm of the gravity of the energy situation and the difficult road ahead and not so much from a

> position of ideological dogma. In essence, building a sound technological base is seen as a prerequisite for survival [7].

What is deeply embedded in these words is the need to 'build the road by walking' and embrace a gradual process of building indigenous capabilities through which innovation can take place and thereby stimulate the process of diffusion. Indeed, the capability to design and manufacture high-tech technologies such as photovoltaic solar cells in Ethiopia is not a realistic target for quite a while to come, but other intermediate and home-refined technologies are certainly within reach; and some modest progress has been made over the past decade. However, an essential element in moving away from this rather exogenous mind-set is the need to connect with community needs and potentials, which somehow need to find their way into the higher education programme. In the words of one of the leading development experts in Ethiopia:

> …there has to be a departure from the traditional methods followed in technical colleges and universities in Ethiopia which are essentially geared to meeting the needs of urban areas and as a consequence there is limited interaction between scientists (and engineers) and the rural and urban poor whose cause they can champion. The main objective of this institute is to create a critical mass of researchers working in different areas of technology adaptation and innovation, which address the technical poverty in rural areas. This means that the process of learning is not just confined to understanding engineering concepts in the abstract but also to apply them to respond to real problems people face [8].

In many respects, the above two commentators are appealing for a concentration of effort to address a complex set of problems that demand the blending of multiple skills, ranging from technology design to technology management, and from social anthropology to marketing.

3.3. Manufacturing and adaptation of new technologies

Developing technical skills to manufacture and adapt new technologies involves bringing together the various players to collaborate and benefit from each other's strengths. Many of the renewable energy technologies require the input of a range of skills and experiences, and therefore the various technical tasks would need to be carefully shared by the relevant people. As much as possible, it is important to bring in potential manufacturers of systems or components from the private sector and NGO community, and given sufficient support and regular training to upgrade skills. Whether this can be better conducted by donors, government or the private sector itself depends on the maturity of the market, and the extent to which the private sector sees itself as a major stakeholder.

3.4. Installation, and operation and maintenance of technologies

The need to develop local and regional technical skills to install, operate and maintain (O&M) energy systems cannot be overstated, and many rural energy projects have failed simply because they did not put in place the necessary technical support to keep them going. There are a number of areas where developing local technical support would be

beneficial: (1) to create local acceptance of the technology, (2) to create a self-sustaining system through local technical self-reliance, (3) to create employment opportunities for local entrepreneurs and technicians, (4) to allow for a speedy response to technical problems encountered. National and regional government rural energy strategies can play a significant role in encouraging and assisting in strengthening local technical support system through innovative funding and training schemes. The problems related to the absence of such 'capacity' are illustrated in the following example.

In the mid-1980s, the then Government of Ethiopia embarked on its *Villagisation Programme* to resettle rural households from dispersed and 'ecologically unsound' farmlands into newly established villages on 'underutilised fertile land', with a view of increasing productivity on a cooperative arrangement. Over a period of 4 years, some 12 million people were resettled into these newly built villages. Many of the villages along the Rift Valley (50–75 villages) were provided with their own Australian Southern Cross windpump, which were installed by an Italian NGO [4]. The need to urgently implement the programme, primarily driven by political imperatives, meant that the windpumps were installed in haste and without building the human capacity necessary to ensure long-term service. Within a year of the Italian NGO's departure from the scene in the late 1980s, the windpumps started to fail one by one, largely due to the lack of routine maintenance. With no technical support at hand and the gradual loss of government interest in its own programme, the villagers turned to car mechanics and other technicians at nearby towns to assist them with the repairs. The local technicians quickly carried out their own 'learning by doing' as they saw windpump repair as a potentially valuable source of income. This has had two effects: firstly, existing skills have been adapted to suit a new market and any new windpumps introduced would benefit from this experience. However, a second effect is that the experience illustrated the importance of providing windpump specific technical training to local mechanics whose repair job is still not of adequate standard. The villagers' perception is that the technicians now know that they are in a monopoly situation and have been deliberately carrying out substandard repairs which frequently failed, hence ensuring continued business.

As a latent response to the recurring problem of lack of locally available O&M capability, some villagers were given basic training to carry out minor repairs and maintenance. However, the issue of putting in place the mechanisms to undertake 'big' repairs continues to be problematic, and so far little effort has been invested in training local technicians on the 'nuts and bolts' of windpumping technology. One important lesson from this experience is that in the absence of an on-going human capacity development, even an elegant and functional option such as windpumping can end up being more costly in practice than was originally intended.

The fact is that rural people have participated in government and donor supported energy activities believing that these 'outsiders' know better and have control over the purse, which partly explains why their participation has been mostly 'passive'. They have been regarded as receivers of services, rather than 'active' participants as direct contributors to or stakeholders to the development concerns. With the rapid decline of government support and the number of donor funding programmes, rural people and organisations are encountering difficulties subsisting under diminishing resource conditions. There is now a growing realisation that dependence on donors and government support is not (and has never been) the answer to their future development needs. Indeed, more than anyone else they are acutely aware that relying on 'outsiders' for funding and

technical support does not automatically translate into security and continuity of service if they remain passive observers rather than custodians of their collective interests. The apprehension regarding the scarcity of locally based skilled and semi-skilled human resource to operate and maintain energy technologies was expressed at the Work-Amba solar pumping site in Northern Ethiopia.

The Work-Amba 1.6 kWp PV Pumping system, which provides water for 3000 people, was installed in 1994 under the UNICEF-assisted rural water supply programme, and is administered by the water committee directly voted in by the community. A few months after installation, a discussion with the village leaders revealed an unexpected observation [4]. They detailed their discontent with the way the installation procedures were conducted, particularly at how the head of the installation team cordoned off the site until the installation was completed. Perhaps the technicians' were 'only doing their job', but people saw their behaviour as an act of the unwillingness on the part of the installation team to share technical knowledge as summed up by the water committee chairman:

> …we do not want to call them for help every time something minor goes wrong with the pump, we need to be trained and given a share of the knowledge up to the point we are capable of understanding. But they want us to be dependent on them for technical assistance because they have no faith in our potential, and it also makes good business sense to them.

Another member of the water committee had the following to add:

> …there is great appreciation for this new technology. In the past, there was no method of water pumping, and people relied on their labour to procure water from the well just outside of the village. As you can see now not only has this made life easier for people, but the cattle are also getting sufficient amount of water, and the surplus water is used to irrigate a small cooperative vegetable garden. If the pump stops functioning, we will be in serious trouble. It is very important for us to have people here who have some idea of how this pump works and to carry out minor repairs when possible.

The statements from the village leaders indicate that while they welcome the new technology to help them meet their basic water requirements, they would also like to ensure that they have sufficient local technical backup for the upkeep of services. Such anxieties emerge from the realisation that improved technologies can make a dramatic impact on their livelihoods, but this effect can only be sustained if people are prepared for the inevitable—equipment will break down. The purpose is therefore to decrease the frequency of breakdowns by regularly monitoring and ensuring that the personnel is available to handle repairs in the event of a major disrepair. Indeed, there have been so many missed opportunities over the years in Ethiopia and elsewhere in the Third World [9] where donor funded technical interventions have brought short-lived improvements, requiring lifestyle adjustments, only to be discontinued due to wholly avoidable technical failures. The relics of these unfulfilled expectations lie littered across the country as reminders of misguided and indifferent interventions on the part of donors, NGOs and government agencies whose commitment to a specific local area is transitory at best.

3.5. Administration and management of projects and schemes

This is a highly underrated area of human resource development. The need for administrative skills to collect revenue and tariff, run bank accounts, keep books and make payments for services go hand in hand with the requisite technical training. People who are given the task of 'care takers' of energy systems are very important players in maintaining order of how the systems are operating. Quite often, the people deployed are the main link between the 'big' administrators based in urban areas and the local end users. Whenever there are difficulties of any kind these local administrators have to articulate the concerns of the end user to the main institutions and policy makers. It is therefore very important that these people are recruited from the local area and given the appropriate administrative training to undertake the day-to-day running of the plant.

3.6. Conflict resolution skills

The rural energy sector today is characterised by a multiple stakeholder environment in which an increasing number of interest groups are obtaining a greater role in decision-making about energy and rural development. These groups, which includes NGOs, CBOs, private sector, government agencies, and individual end users, often have widely differing opinions, objectives and knowledge about energy. The presence of multiple and competing interests undoubtedly adds to the richness of discussions in the energy field, but it also implies that the potential for conflict between the various stakeholder are increased. Thus, rural energy institutions (government and NGO) are finding out that there is a real need to understand the causes and consequences of conflicts over the ownership, management and use of energy resources. Their role as facilitators of conflict management between the disagreeing parties has become increasingly important. Conflict management is based on dialogue leading to mutually acceptable solutions, and forging partnerships where mistrust and discord have prevailed and to focus community action on issues that directly affect everyone.

Conflict management requires communication and learning skills, which are central to coordinating negotiations, eliciting views through public participation, and building consensus within the rural community and between leaders. The specific training areas should involve basic conflict resolution techniques and intervention skills for dealing with emerging social, economic, technical, and cultural conflicts. NGOs and CBOs can be key players in carrying out conflict management exercises directly and training local communities in strengthening their negotiation skills, since they have a long track record of working closely with rural communities.

In the late 1990s, an Intermediate Technology-Zimbabwe (ITZ) supported micro hydro project in an Eastern Highland village of Nyamarimbira, Zimbabwe was stalled because of conflicts emerging from an alleged favouritism [10]. During the early phase of construction, it emerged that one of the village leaders was said to have paid his 'friends' for their labour from the project funds. This was not well received by the other villagers who were providing their labour in kind. Their collective response was to refuse to participate in the project work. To complicate matters, no one was willing to voice their displeasure in public, so the matter could not be resolved through public deliberation. The ITZ team recognised that people in the area played a major role during the liberation war in carrying out and supporting clandestine activities, and many of the guerrilla fighters

were based in the region in villages such as Nyamarimbira. Thus, the custom of 'not giving your fellow comrades away' was firmly internalised as part of the cultural norm, even to this day, which renders 'normal' negotiations procedures futile. The ITZ team set out to speak to each of the prominent people to try and resolve the disagreement and for the project, which clearly had much to offer to their energy needs, to continue. This did not resolve the matter immediately, although it brought the momentum of dialogue, reflection and reasoning to these influential individuals. Through this process, the ITZ team was able to identify the person who was most interested to resolve the stalemate once and for all, who took no side in the dispute even in private discussions, and widely respected in the community at large. This gentleman took the role of talking to the targeted individuals on behalf of the stakeholders about the importance of the project to their community, which ultimately yielded the desired result in arriving at a mutually acceptable agreement in resolving this local conflict.

The importance of this experience is that the ITZ team were quick to realise that the only way the dispute could be resolved was if they stepped aside and allowed an insider to articulate their concerns, which also coincided with his and the wider community. However, the process of arriving to that point required experience in dialogue and mediation, and a keen understanding of the cultural and historical characteristics that are specific to the Nyamarimbira area. Without those negotiation and balancing skills of the ITZ team and indeed their 'insider' mediator, the project would either have collapsed or would have taken longer to restart. The project continued where it left off, with a whole new and unanticipated experience in conflict resolution.

3.7. Making institutions relevant to rural energy development

The institutional infrastructure is an important component in the drive for the implementation and promotion of rural energy programmes. The collective makeup of institutions should therefore provide the platform required to ensure that regulations are adhered to and the mechanisms by which technologies can be developed, adopted, refined and disseminated are in place. In essence, institutions are the cement that holds together and manages the various actors and inputs needed to promote sustainable services. An effective institutional infrastructure ensures the continued delivery of benefits long after donor assistance has ended. This implies that institution building for technology development and dissemination should build judicious partnerships between the various actors involved.

3.8. Current institutions on rural energy in ethiopia and their effectiveness

The Ethiopian Ministry of Mines and Energy (MME) has the overall responsibility for the energy sector in the country, including policy issues concerning exploration of energy resources and the implementation of national energy policy. Under the MME, there are several departments that focus on various parts of the energy sector, including the rural sector which is the responsibility of the Ethiopian Rural Energy Development and Promotion Centre (EREDPC) [11]. In line with the country's decentralisation programme, the energy sector is incorporated in the Bureau of Water, Mines and Energy with a few exceptions where energy activities are grouped under Urban Works [12]. The EREDCP

provides support to each energy bureau, which has the mandate of energy development within its administrative jurisdiction.

The new energy policy was approved by the government in 1994 is currently being implemented (Ministry of Mines and Energy, 1994), giving due emphasis to harnessing hydropower resources, a shift towards an increased use of modern fuels and the development of effective human and institutional resources. The policy also made specific reference to energy efficiency measures and the need to incorporate ecological and environmental principles to energy interventions. The policy was followed by a review of the current legal and regulatory framework of the power sector and established the Ethiopian Electric Agency in 1998 to administer activities related to power generation, transmission and distribution. In specific terms, this involves issuing licences to electricity producers and suppliers, ensuring that activities in the electricity sector comply with the regulation, and monitoring that high-standards and quality of service are maintained.

Despite the widespread debate about privatising existing power utility assets across the developing world, including Ethiopia, the Ethiopian Electric Power Corporation (EEPCO) remains an autonomous public enterprise, wholly owned by the Ethiopian Government. EEPCO has the responsibility for generating, transmitting, distributing electricity across the country, mostly in large urban centres. In recent years, EEPCO has given its commitment to extend electricity cover 160 'woreda' (district) towns in Regional States as part of the government's Agricultural Development Led Industrialisation (ADLI). This is a departure from previous engagements in rural electrification (RE) where rural towns or villages were electrified following requests and once the feasibility studies and designs were undertaken [13].

The question remains whether these institutions are sufficiently prepared to engage with the rural energy shortfalls that the country has faced for quite sometime. In the past, much of the activity has remained within specific resource sectors namely biomass and the idea of extending modern energy services to rural areas was seen as a remote and unaffordable undertaking. The focus of electrification therefore remained fixed on meeting the urban demand with investment in rural energy amounting to 0.1% of the total energy sector investment over the past decade, much of which was spent on biomass fuel conservation [12]. Here are some observations that need to be addressed if the current impulse characterised by the government's ADLI programme is to materialise into concrete steps towards improving energy services in rural areas.

Improvement of institutional interlinkages amongst the local, regional and national bodies involved in rural energy issues: There is still much to be done in improving communication between the various Woreda, Zone, Regional and Federal levels who are engaged in rural energy activities. At the moment, this appears rather disjointed and chaotic as there are no tangible mechanisms that enable for effective information transfer and lessons to be shared between regions, hence there is a tendency to duplicate old approaches and 'failures'. Part of the problem is of course the limited human capacity at just about all levels, but there are also shortages in managerial competence able to mobilise resources effectively beyond the Federal level down to the Woreda and village levels. Moreover, with the new policy of further decentralisation that was brought into effect in July 2001 to bring decision making to the Woreda level, the problem of guidance and administration may well be exacerbated.

Energy must be seen as an integral part of overall developmental goals and must not be seen as separate from other sectoral development plans and strategies: Traditionally, energy inputs were regarded as add-ons by other sectors such as health, education and water. It is

important that these social development sectors recognise the impact of improved energy services to their overall effectiveness. From an energy perspective, rural schools are failing to provide adequate service because either their energy expenditures are prohibitive or simply they have no access to modern energy services. In similar vein, rural health units are often constrained by energy supply shortfalls, particularly for lighting for night-time medical service and sufficient energy to run an adequate cold chain facility. This implies effort needs to be directed to capture the full synergetic benefits of co-ordinated action between the various social development sectors and the energy sector. One possible way to overcome this difficulty of 'co-ordination' is to set up energy departments that would help synchronise their sectoral efforts with those in the energy sector. This can be carried out both at Ministerial as well as Regional levels.

The current below subsistence level energy consumption in rural Ethiopia (barely covering cooking and lighting services) demands special policy attention: This needs to be taken on board as part of the government's fight against poverty reduction and creating the mechanism where people can participate in finding solutions which are acceptable to them and that they themselves can sustain. The issue of enhanced energy services cuts across almost all development priorities that the government set in its ADLI programme. Over the years, lack of access to energy in rural areas has not received concrete policy and strategy attention, although it was always recognised as a potential difficulty for communities, but the problem has not gone away. In fact, the issue of energy scarcity (or access to it) is now beginning to be seen as an indicator of poverty and an impediment to social development. This recognition needs to move beyond statements and declarations to concrete action with targets and deliverables.

Establishment of Centres of Excellence in a range of energy technologies: The energy situation in rural areas has now reached such a critical level that it warrants a much more focused attention than it was given in the past. Part of the problem is the lack of skilled and semi-skilled people available across the country to provide essential services from R&D to simple repairs. Establishing dedicated centres of excellence can provide the training platform through which competence can be boosted to meet the technical demands in various energy technology specialities, in the service of both public and private sectors. Such centres can also bring people from various Woredas or Regions to exchange experiences and insights. For example, a recent field visit to the Somali Region was able to establish that over half of the 30 solar refrigerators dotted around the Region's health facilities are currently not operating. A large number of these expensive, but essential life saving equipment have operated for less than 5 years, much less than their expected 20 year lifetime. Very probably, the majority of these refrigerators are currently out of order for reasons of lack of maintenance and small repairs. The paradox of all this is that the Somali region has the lowest child immunisation rate at less than 5%.

Political commitments must be made regarding the importance of utilising environmentally and socially responsible energy technologies in order to avoid the pitfalls of the past and move towards sustainable energy futures: It is important to emphasise at the highest level that Ethiopia has no alternative but to innovate on many fronts in order to be able to produce a stable supply of energy to the rural areas. In concrete terms, this means increased resource allocation in favour of harnessing woodfuel energy sources as a priority and further developing the infant, but potentially crucial area of renewable energies. By moving in these directions, Ethiopia will be in a position, in the long-run, to contain the aggravating

energy crisis and at the same time satisfying the energy requirements of its rural population without neglecting the obligation to protect the natural environment.

I*nnovative fund raising is a vital priority*: There is a conventional argument that people in Ethiopia cannot afford to pay for modern energy services, and therefore it is difficult to make the case for expanding access on the basis of perceived need. Given the earning capacity of households across the country, the question of 'ability to pay' will be a significant challenge to grapple with. Then, what needs to be done to the 90% of the country's population who have no access to decent quality energy services. Are they not entitled as citizens to better energy services, at least, to run their schools, water and health facilities to the minimum standard? These are fundamental ethical questions that cannot simply be reduced to issues of affordability and cost-benefit equations. They are questions that go to core of defining the nature of the State and its constituent leadership and the relationship its has with its citizen and their welfare. Investment in social development sectors is an essential role for the government, and given that energy is an essential 'enabler' of such sectors, raising financial resources for its expansion is a necessary intervention. There can be a number of different ways this can be achieved: cross-subsidisation through a small levy on existing EEPCO clients, social development tax, revolving fund system where users (facilities) pay the running cost for autonomous systems, Diaspora tax, tax break for private entrepreneurs in rural energy etc.

Finally, it is worth deliberating on an interesting biogas programme in Nepal as a useful illustration of a 'successful' programme that incorporated many of the above observations.

As in Ethiopia, in Nepal there is a seemingly endless demand for fuelwood which is used mainly for cooking. The pressure on forests has reached unprecedented levels and deforestation, soil erosion and landslides occur frequently. Recognising the urgent need to find an alternative source of fuel, the Nepalese Government, the Netherlands Development Organisation and local banks set up the biogas support programme (BSP) in 1992 to promote household biogas plants using animal dung as an available and appropriate fuel. As a result, biogas is being produced in family units for domestic purposes, such as cooking and lighting. There are now over 65,000 plants operating across 61 districts in Nepal, representing a huge leap from the 6000 units that were installed prior to the pre-BSP initiative [14].

What is impressive about this BSP scheme is not solely the number of biogas plants that have been installed but also the financial and institutional instruments that were created to sustain the programme. From the outset, the project team recognised four of areas that were crucial to the achievement of their objectives: effective design and quality control mechanisms, proper channeling of subsidies and loans, involvement of local component manufacturers and installers, and participation of banks.

Subsidies to companies installing biogas plants (33% of capital cost) are only given on agreement with the BSP. The agreement is negotiated with the companies, donors and government before being approved. BSP can then sanction penalties against companies which install biogas plants which are not up to the quality standards. Six teams in the field carry out quality inspection, and over 800 plants are inspected per year. Each plant has a 3-year warranty, and 5% of the plants are inspected per year.

All recognised biogas companies use a single quotation, as a result the cost of the plant is not competitive but rather stable. This has created a relatively secure business environment where the principal purpose is to construct plants that meet the quality standards set by the BSP, which include 73 codes related to labour, design, materials, and construction.

Bonuses are awarded to those companies that fully comply with these rigorous standards as an additional incentive to maintain quality. Over the past 10 years, the number of companies has risen sharply from one in 1992/1993 to 11 in 1993/1994, 23 in 1995/1996, 36 in 1996/1997, and 50 in May 2000. The growth is not confined to biogas companies, but also to appliance manufacturers. Similarly, there was only one GGC workshop for the fabrication of biogas appliances in 1992, which has grown to 13 local and three international recognised biogas appliance suppliers in the country. All in all, there are over 2000 people working in the biogas industry in Nepal, most of whom received the required training through the BSP scheme [15].

The encouraging result of the above interventions in capacity development and linking finance with performance is the high success rate of functioning plants. By 2000, some 98% of the installed plants under the BSP scheme were providing high-quality service. This is clearly a major achievement given that it is often the case that the issue of techni cal sustainability remains a major challenge in most energy interventions in rural areas. The Nepalese experience seems to indicate that technologies are only as good as the nature and quality of the supporting mechanisms in place to maintain continuous service. The message is glaringly clear—introducing new technologies is only a start towards creating an improved technical environment, but the real crux is how to bring about technical feasibility which embark on deliberate measures to install 'enabling' regulations, incentives, and protection for those involved as suppliers and users.

Recently, the Ethiopian Government in collaboration with the World Bank initiated its Energy Access Programme, aimed at increasing access to electricity and improving the quality and adequacy of electricity supply. As the lead financier, the World Bank provides $133 million out of the total of $200 million. The loan was granted to the Ethiopian Government at an interest rate of 1%, which then transfers the loan to EEPCO at 6% interest rate. The 5% difference will be used by the government to finance its rural electrification programme with the aim of reaching as many as 20% over 10 years through grid and off-grid initiatives. This project is the largest of its kind relating to rural electrification in Ethiopia, and has aroused a great deal of attention and optimism about the government's seriousness to address the long-neglected issue of extending electricity coverage to rural areas. No doubt, in the end the success of the project will be appraised by its capacity to meet its set of 'conventional' targets. However, this will not be a sufficient measure of overall effectiveness. The project must demonstrate the extent to which it has introduced appropriate regulatory frameworks that can monitor quality and maintain standards, assembled strong institutions that can facilitate communication, financial arrangements and managerial requirements, and built sufficient local human resource that can carry through sustained electrification programme in future years. This will not be easy but as the Nepalese experience clearly established, the sustainability of such programmes requires committed leadership with a clear vision of the way forward that incorporates innovative thinking (sometimes unconventional) and a continual observation of the capabilities, limitations and potentials of user communities. Most importantly, the project management team must be prepared to learn from new experiences and quickly integrate these lessons to consolidate efforts on sustaining 'good practice' and put in practice on-going evaluation mechanisms of their activities. Here, the focus should not be on 'unimportant successes' but rather on 'important failures'.

4. Conclusion

Technology is a combination of knowledge, techniques and concepts; it is tools and machines, farms and factories; it is organisation, processes and people and the cultural and historical context in which these interactions take place. In effect, technology is the science and art of getting things done—through the application of skills and knowledge [16]. As such, the historical legacy of energy technologies to human development is without question. Indeed, the way in which we, both as individuals and communities, live our lives is fundamentally determined by the energy resources available to us. This assertion applies to previous generations as much as it remains relevant to current and future generations in their effort to maintain decent levels of living conditions. In effect, energy has a key role in shaping the process of social and economic engagement so much that each major economic and social change has been accompanied by specific energy consumption and supply patterns. While it would be reductive to compose the history of human development in terms of energy [17], the realisation that energy is an essential input in changing society remains a powerful incentive to mobilise efforts towards improving access to energy resources. This remains an important development challenge for Ethiopia in the coming decade.

Low energy consumption is not necessarily a cause of poverty in Ethiopia, but the lack of energy appears to correlate closely with many poverty indicators such as high rates of illiteracy and infant mortality. Therefore, the underlying objective of rural energy activities is to provide households and communities better access to modern energy services. At the level of the individual, the provision of improved energy services, both in quality and quantity, can transform the quality of people's lives. They can improve people's productivity and welfare by 'emancipating' women and children from the daily drudgery of water and fuelwood collection, providing lighting to extend the working day, and offering people the opportunity for better health care and educational services. At the community or national level, the empowerment of people and improving their living conditions leads to the emergence of a healthier and better-educated community which is an asset to a country that is engaged in progressing beyond a subsistence economy.

The modalities by which modern energy provision is realised is an area that is currently receiving attention in Ethiopia. Evidence from elsewhere shows that countries that have engaged effectively with expanding access to modern energy services have exercised a great deal of foresight and vision preparing the platform for technology adoption and diffusion. This means setting up the organisational and institutional environment conducive and supportive of efforts and capacities beyond the time of project completion, for example. Another important area of effective engagement is that the human components of capacity development are put into effect to ensure that people are equipped with the understanding and skills, and the access to information and knowledge to perform effectively. These are areas that certainly require much deliberation in Ethiopia where developing capacity to undertake meaningful action to alleviate problems in the rural energy sector is long overdue. There are ample good (and bad) examples of how to sustain energy programmes through careful supervision, combined with the flexibility to adjust in accordance with the insights gained during implementation. However, the Ethiopian energy sector has to embark on its own version of capacity development, drawing useful lessons from experiences elsewhere but firmly rooted on specific local conditions. At the danger of forcing the debate, the current level of low-quality public service provision in rural areas

requires deliberate intervention, both in terms of upgrading the quality of service and its reach to cater for larger numbers of people.

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